Acquisition Directorate
Research & Development Center

Report No. CG-D-06-15

# Cost Benefit Analysis of Boat Lifts

**Distribution Statement A:** Approved for public release; distribution is unlimited.

**September 2014**

Homeland Security

# N O T I C E

This document is disseminated under the sponsorship of the Department of Homeland Security in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

This report does not constitute a standard, specification, or regulation.

Mr. Rich Hansen
Surface Branch Chief
United States Coast Guard
Research & Development Center
1 Chelsea Street
New London, CT  06320

Technical Report Documentation Page

| 1. Report No. | 2. Government Accession Number | 3. Recipient's Catalog No. |
|---|---|---|
| CG-D-06-15 | | |

**4. Title and Subtitle**
Cost Benefit Analysis of Boat Lifts

**5. Report Date**
September 2014

**6. Performing Organization Code**
5103

**7. Author(s)**
LT Brent A. Fike

**8. Performing Report No.**
R&DC UDI #1342

**9. Performing Organization Name and Address**
U.S. Coast Guard
Research and Development Center
1 Chelsea Street
New London, CT 06320

**10. Work Unit No. (TRAIS)**

**11. Contract or Grant No.**

**12. Sponsoring Organization Name and Address**
U.S. Department of Homeland Security
Commandant (CG-926) United States Coast Guard
2100 Second St. SW
Washington, DC 20593-0001

**13. Type of Report & Period Covered**
Final

**14. Sponsoring Agency Code**
Commandant (CG-926)
U.S. Coast Guard Headquarters
Washington, DC 20593-0001

**15. Supplementary Notes**
The R&D Center's technical point of contact is LT Brent Fike , 860-271-2891, email: Brent.A.Fike@uscg.mil

**16. Abstract (MAXIMUM 200 WORDS)**
This report includes an analysis to determine if the cost of providing and maintaining boat lifts at Coast Guard Boat Forces units will be offset by the savings from reduced maintenance and repairs needed on boats stored out of the water. Data and results obtained from a one-year in-water evaluation of purchased boat lifts installed at various Coast Guard Boat Forces units are also included. Recommendations are made as to whether the Coast Guard should pursue future utilization of a boat lift solution to reducing long term maintenance costs. Salient characteristics for the recommended style of lift are also identified as part of lessons learned.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| Boat lift, out of water storage, boat storage | Distribution Statement A: Approved for public release; distribution is unlimited. |

| 19. Security Class (This Report) | 20. Security Class (This Page) | 21. No of Pages | 22. Price |
|---|---|---|---|
| UNCLAS//Public | UNCLAS//Public | 48 | |

**(This page intentionally left blank.)**

# EXECUTIVE SUMMARY


The Coast Guard (CG) operates and maintains approximately 1,600 boats service-wide with the majority of these boats assigned to Small Boat Stations and Aids to Navigation Teams (ANT). These boats typically remain in the water ready for operation except during maintenance and repair or when environmental conditions warrant their removal. Standard boats, like the 25-foot RB-S, 29-foot RB-S, 26-foot TAN-B, and 32-foot TBS-B, are issued and delivered to units with trailers. Moorings are also installed and maintained at Coast Guard Stations and ANT facilities. The practice of storing boats in the water when not in use results in additional maintenance for the boats. To alleviate this issue, there are various systems, such as boat lifts, jet docks, trailers, graving docks, etc., that allow owners/operators to store their boats out of the water in a near-ready-to-operate condition.

The purpose of this project was to determine whether the cost savings resulting from boat maintenance reductions associated with out of water storage systems exceed the costs of installing and maintaining an out of water boat storage system. For the purposes of this study, only water boat storage systems with characteristics that would not encumber the rapid launch and recovery of the craft were considered and a total of three were tested. These models included: Hydro Hoist, SunStream, and Jet Dock. The study includes a comprehensive cost benefit analysis over a one year period of use of two of the three boat lift models. This was used to determine whether savings in maintenance and repair costs exceed the costs of owning, installing, and operating an out of water storage system. For the purposes of this study, boat "storage" was considered anytime the boat is not actually underway for operations. There two storage modes analyzed were in-water and uncovered out-of-water.

Based on the results of this 12-month assessment, the Jet Dock system return on investment is expected to be 7 years. The SunStream lift return on investment is expected to be 50 years. Due to lack of data from storm damage the cost model could not be run on HyroHoist. These figures could vary greatly depending on each location's infrastructure and usage of the lifts. It is recommended that decisions on out of water storage be determined on a location based case-by-case analysis verses service wide determination.

The following factors should be considered if the decision is made to utilize a boat lift:

- The response time for launching the boat should be no more than two minutes.
- The time to recover the boat should be no more than five minutes.
- Side-tied lifts should only be utilized when attached to floating piers. Fixed piers must have an independent tide management system installed.
- The ability to walk from each side of the vessel with 270° walk around capability is highly recommended to avoid the potential of mishaps due to jumping across open water to reach both sides of the lift.

With the life expectancy of a boat ramp anticipated at 100 years at an average cost $70,358.00 according to SAMS database, replacing or adding boat ramps would be a more cost effective option to consider. Only in instances of CG boats stationed without a boat ramp in a reasonable proximity are boat lifts a viable solution.

Utilizing the results of this project as a guide, the Office of Boat Forces can determine whether installing and utilizing boat lifts is a cost effective alternative to current status quo methods and make subsequent resource allocations and policy changes on a case by case basis.

**(This page intentionally left blank.)**

# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

| | |
|---|---|
| ° | Degrees |
| ANT | Aids to Navigation Team |
| ALMIS | Asset Logistics Management Information System |
| CG | Coast Guard |
| CIM | Commandants Instruction Manual |
| COMDTINST | Commandants Instruction |
| CT | Connecticut |
| GSA | General Services Administration |
| IAW | In Accordance With |
| NY | New York |
| RBS | Response Boat Small |
| RDC | Research and Development Center |
| ROI | Return On Investment |
| SAMS | Shore Asset Management System |
| SILC | Shore Infrastructure Logistics Command |
| SPC-SW | Special Purpose Craft Shallow Water |
| TX | Texas |

**(This page intentionally left blank.)**

# 1 BACKGROUND

The Coast Guard (CG) operates and maintains approximately 1,600 boats service-wide with the majority of these boats assigned to Small Boat Stations and Aids to Navigation Teams (ANT). These boats typically remain in the water ready for operation except during maintenance and repair or when environmental conditions warrant their removal. Standard boats are trailerable, while other boats require marine travel lifts or other methods to be removed from the water for maintenance and repair.

CG boats spend most of their time in the water, whether they are being deployed for operations or moored for future use or maintenance. Storing boats in the water decreases response time and alleviates storage concerns on land. Unfortunately, seawater and marine life can accelerate boat hull and engine deterioration, which has negative impacts on long term maintenance costs. Additionally, not all maintenance and repairs can be conducted while boats are in the water.

The CG currently employs boat trailers and marine travel lifts to temporarily remove boats from the water. However, these systems require the use of additional infrastructure like boat ramps and finger piers to remove boats from the water, and the boat's removal from the water is temporary. An alternative to these methods and an option for long-term out-of-water storage are boat lifts.

As an alternative to boat ramps, implementing the use of boat lifts could result in time savings for crews trailering the boat, reduced maintenance time spent cleaning the boat hull upon trailering, and transporting the boat from current moorings to a local or CG boat ramp. Station locations that are not afforded a nearby boat ramp for trailering operations may leave the boat in the water for extended periods due to increased transit times for trailering the boat. For marine travel lifts, using boat lifts could result in similar operational and maintenance time savings.

# 2 STUDY LOCATIONS, LIFT SELECTION, AND CONSIDERATIONS

## 2.1 Lifting Requirements and Floating Lifts

The study included a thorough investigation of commercially available lifts and considered multiple styles and varying configurations of lifts for use in the year-long assessment. . Major considerations included required inspections for lifting devices, routine maintenance recommended by the manufactures, infrastructure required for lifts, expected life span, and State or Federal permitting required for the use of lifts. The CG has additional requirements on lifting devices which include an annual weight test, an annual lift cable renewal, a record of appliance of overhead lifting devices in accordance with Commandant Instruction Manual (CIM) 16500.21A, and Shore Infrastructure Logistics Command (SILC) requirements. These requirements drove the decision to use free floating lifts for the study. Free floating lifts decrease the burden on crews and SILC required inspections and ultimately decrease labor hours spent maintaining the equipment.

## 2.2 Unit Selection for Lift Placement

Prior to selecting specific boat lift models for evaluation, the project team identified multiple CG units with variety of weather conditions and liftable boats. Three initial locations selected for boat lift placement included; CG Station Shinnecock in New York, CG ANT New York in New Jersey, and CG Station New Haven in Connecticut. These units had adequate mooring space and shore infrastructure to support the floating style of boat lifts, making them desirable for the assessment. Unfortunately, shortly after installation, Hurricane Sandy made landfall in the area and destroyed all three lifts. Details are included in Appendix B.

Due to the long term damage caused by Hurricane Sandy, the project team selected a new assessment location at CG Station Sabine Pass in Texas. This location is home to three different liftable boats including the 25-foot RB-S, 29-foot RB-S, and 24-foot SPC-SW. This location also has the waterfront infrastructure necessary to keep the test of all three lifts in one location. CG Station Sabine Pass also has a nearby boat ramp, (within 1 mile of the Station) for normal trailering operations. This precluded any lift failures from being an operational issue.

## 2.3 Lift Selection

The selection criteria for the three lifts tested in New York, New Jersey, and Connecticut were based solely on price. The three tested lifts were side-tied and free floating in the water which meant that the boat aspect and movement would change with the environmental conditions. Station's boat coxswains initially expressed concerns in using the lift to dock their vessels. If the lift launch and recovery process changed the boats trim in excess of 15° relative to the normal vessel trim, the crew had to engage the propellers to maintain the boat's position in the lift. The additional movement caused by environmental factors created an extra burden on the coxswains and crews compared to mooring to a fixed pier. Additionally, docking a vessel to another floating moving dock, tied to a pier that has to be lined up with precision to maintain the keel to the appropriate aspect can be daunting. After multiple cycles, the coxswains and crews became more comfortable and increasingly efficient in the process. However, the Station decided that the side-tied, free-floating boat lift design was not desirable. A boat lift that is fixed to a floating pier that raises and lowers with tides and other vessels wakes alleviates the issues encountered with the side-tied, free-floating design and is more desirable.

When the first three lifts were destroyed in Hurricane Sandy, the team employed lessons learned and developed new requirements to select two new lift models for the assessment. The final characteristics included; attached to the pier, 270° degree walk around, solar powered, lifting capacity for 25-foot RB-M and 29-foot RB-M Gen II, two-minute time to launch, five-minute time to recover, state and federal permitting requirements, and the water depth at pier necessary to raise and lower the boat. Two additional solicitations were then drafted for CG Station Sabine Pass.

Prior to selection of the free floating lifts from commercial vendors, the team conducted a thorough Government Services Agency (GSA) search to identify boat lifts capable of hoisting the specified CG boats. The team compared lift price against lifting capacity (Figure 1) using the Naval Sea Systems Command report to Congress (Appendix A). Capacity versus costs of GSA available lifts allowed for more accurate Initial Government Cost Estimate (IGCE).

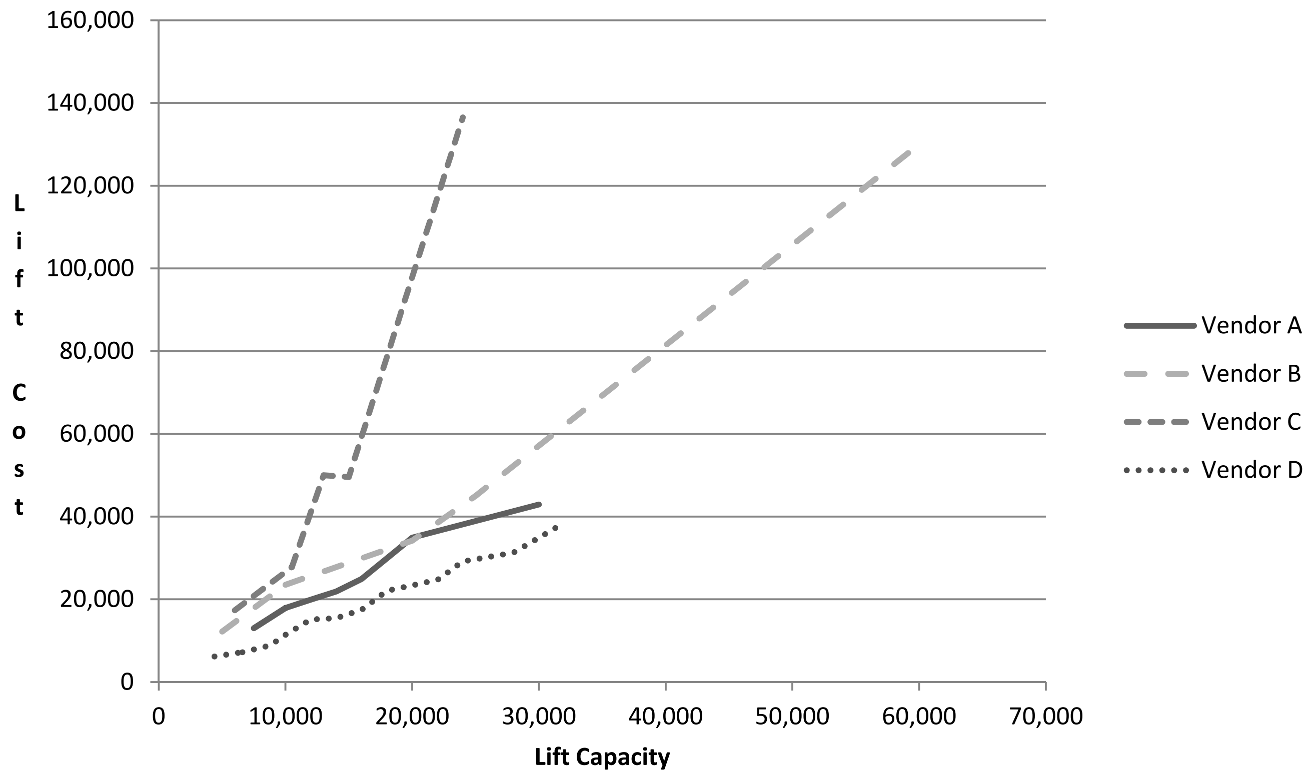


Figure 1. Capacity vs. cost.

In the month of July 2013, two separate lifts were installed. The Jet Dock D-01-21-PD-101 and the SunStream Float Lift GFL10014AS. Manufacturer technical representatives from both companies installed the lifts in accordance with the statement of work. The on-site representative also trained the crews to properly operate the installed lifts. The project team distributed monthly surveys (Figure 2) to the engineering department to collect number of times cycled, maintenance preformed on the lift, days the lift was used, problems experienced, and general comments on lift operations.

**Project: Cost Benefit Analysis of CG Using Boat Lifts**

**Boat Lift Monthly Report**

Unit Completing Form:____USCG Station Sabine Pass TX_____________________________

Month Data Collected:__________________________________

1) Which boat(s) used the Boat Lift this month? List hull number(s).

2) Number of times the Boat Lift was cycled (one cycle is one lowering and one rising)?

3) How many days (full or partial) was a boat(s) moored in the Boat Lift in the raised position?

4) How many days was the Boat Lift left empty & unused?

5) For question #4 above, state why the Boat Lift was empty those days; for example, boat underway for multi-day trip, boat trailered for maintenance, Boat Lift inoperable due to equipment casualty, etc.

6) What maintenance was performed to the Boat Lift (Write "none" if none completed)?

7) Did your crew replace any Boat Lift parts? If yes, list what parts and state if replacement was due to failure or as part of regular maintenance.

8) Did the Boat Lift experience any equipment problems this month?

9) How many times was the boat trailered for maintenance that could not be performed while the hull was in the Boat Lift?

10) List any Maintenance Procedure Cards (MPC) completed to the boat(s) while the boat was actually in the Boat Lift this month. If different boats use the Boat Lift, please include the hull numbers associated with each MPC to distinguish one from another.

11) Please state any general comments about the operation of the Boat Lift this month or any impacts to training, maintenance or operations.

Date Form Completed:

The EPO or his designated POC must complete this form at the end of each month. Forward it electronically to the Research & Development Center project officer by the 5th day of the following month.

If you have any questions or problems during the project, please contact LT Brent Fike at the R&D Center at (860) 271-2891or via email: brent.a.fike@uscg.mil

Figure 2. Monthly survey.

### 2.3.1 Jet Dock Boat Lift

The Jet Dock (Figure 3) purchase included installation and training for the crew.

The Jet Dock salient characteristics assessed included launching and recovery time. The Station launched the 25-foot RB-S in under two minutes. The Station took longer to recover the boat at an average time of three minutes and 25 seconds. These times fell within the stakeholder desired range for launch and recovery time. The lift also was fixed to the pier via tide manager poles that allowed the lift to rise and fall with the tide and vessel traffic wakes. To maintain stability in the lift, the RB-S was anchored at three locations to the Jet Dock: one point at the eye hook on the boat's bow and two ratchet straps located about four-feet aft on the port and starboard side of the bow.

The team monitored the performance over a 12-month period for any breakdowns or issues. The Station reported only one incident over the year, which was quickly resolved. The crew initiated a call to the technical representative to report a slow response time lifting the vessel out of the water. The technical representative quickly diagnosed the problem as the forward tide manager poles being tied too tight. The Station slacked the lines two-inches and alleviated the problem. Other than this one issue, the Station continually praised the performance and ease of maintenance of the Jet Dock boat lift.


Figure 3. Jet dock.

### 2.3.2 Sunstream Boat Lift

The purchase of the SunStream Boat Lift (Figure 3) also included installation and training for the crew. Like the first three tested lifts, this lift was side tied to the pier. The team selected this boat lift design due to its rapid launch and recovery capabilities and its ability operate with no outside power in the event of an emergency. The SunStream allowed the 24-foot SPC-SW to be launched in less than one minute and recovered in less than one minute, due to its hydraulic design. The SunStream had an accumulator which stored hydraulic pressure that could be utilized in the event of a power loss up to two launch and recovery cycles.

The team also monitored this lift for a 12-month period. A common issue that the team encountered included the lift catching under the pier, which posed a risk to stability of the lift itself as one pontoon rose while the other remained trapped under the pier. The Station tried to alleviate this issue by tying the lift across to the other side of the pier, but their attempts were unsuccessful. . Additionally, while conducting boat checks, a crewmember slipped between the pier and boat lift and fell into the water while transitioning from the lift to the pier. The crewmember suffered bruised ribs and lost three days works as a result of the mishap.

The Station attempted to continue to use the lift for another month with it being caught under the pier more frequently and ultimately decided the lift was added more maintenance to their schedules than value to their operations. The Station relocated the lift to an adjacent unutilized pier and discontinued its use after five months. Had the infrastructure been a floating dock side-tied to the SunStream lift this problem could have been alleviated. The project team transferred the lift to another unit at the end of the 12-month study with the appropriate pier available for the lift.

Figure 4. SunStream lift.

## 2.4 Lift Considerations

### 2.4.1 Launch and Recovery Time

At the onset of this project when the project team discussed desirable characteristics for boat lifts and boat, launch and recovery times were a major concern. The longer it takes to launch an asset, the longer the response time. Many Coast Guard search and rescue calls, like medical emergencies, persons in the water, or a vessel in distress, are urgent in nature and require a quick response. The first brand of lift purchased took approximately three to four minutes to launch a 25-foot RB-S and seven to nine minutes to recover. Time waiting to launch a response vessel must be quick and cannot impede the crew's ability to arrive on scene. Important characteristics to consider prior to purchasing a lift should include launching the boat within two minutes and recovering the boat within five minutes.

### 2.4.2 Long Term Maintenance Costs

Lift maintenance over its lifespan is currently unknown. Searches yielded many different costs varying from manufactures stating 150 percent of purchase costs per year to zero costs. Over the one-year study, only one maintenance item required expenditure to maintain the lift in operation. A longer study would have to be conducted to achieve the life cycle cost of the lifts themselves.

# 3 COST ANALYSIS

During the 12-month period of usage at CG Station Sabine Pass, the Station completed five boat maintenance procedures on the SunStream boat lift and 18 on the Jet Dock boat lift. The maintenance included a weekly corrosion/hull inspection of the 25-foot RB-S and SPC-SW. The project team tracked and logged these maintenance hours into Asset Logistic Management Information System (ALMIS). The project team utilized these hours for the cost analysis. All cost figures associated with this report utilized the hourly rates for personnel from COMDTINST 7310.1O.

With an average completion time of two man hours at the E-5 level and .5 hours on the E-6 level, the average cost of the weekly corrosion/hull inspection was $126.00 when utilizing the boat lift for a mooring platform vice trailering the boat. Boat trailering procedures require five personnel to complete. The trailering evolution consists of two persons in the truck towing the trailer and three persons for coxswain/crew of the vessel to transit to the ramp. The complete trailering evolution lasts, on average, 45 minutes. With two persons at the E-5 level, one at the E-4 level, and two at the E-3 level, the average cost to trailer a vessel at CG Station Sabine Pass is $156.75. Adding the trailering and maintenance costs together returns a savings of $282.75 per event at CG Station Sabine Pass. The cost savings for each CG unit will vary as it may take longer or shorter to drive to and from a boat ramp facility for boat trailering evolutions.

## 3.1 Lift Cost Analysis

The project team developed spreadsheets for each class of boat being studied. The spreadsheets identify completed required maintenance for each boat class and the cost savings or loss as compared to normal operations prior to using the boat lift. If the cost of a maintenance procedure is the same regardless of storage mode they are excluded from the spreadsheet (Tables 1 and 2).

Table 1. Jet dock boat lift benefit.

| Jet Dock Boat Lift Cost Benefit | |
|---|---|
| Purchase Price | $35,223.37 |
| Shipping | included |
| Local Unloading | included |
| Total Investment | $35,223.37 |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| 1 Year Cost Savings Total | $5,089.50 |
| Estimated Years to payback | 6.9 |

Table 2. Sunstream boat lift cost benefit.

| Sunstream Boat Lift Cost Benefit | |
|---|---|
| Purchase Price | $27,765.88 |
| Shipping | $4,387.00 |
| Local Unloading | $950.00 |
| Total Investment | $33,102.88 |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Hull Inspection | ($282.75) |
| Sun Fluid Replenish | $755.00 |
| Hull Inspection | ($282.75) |
| 1 Year Cost Savings total | $658.75 |
| Estimated Years to payback | 50 |

## 3.2 Boat Ramp Alternative Price Analysis

The project team also considered boat ramps as an alternative to boat lifts. If space and shore infrastructure are available, boat ramps are a potentially a cost effective solution. An investigation into CG owned boat ramps was conducted through Shore Asset Management System (SAMS). SAMS allows for installation costs to be computed factoring in area discounted price specifics. For the 85 boat ramps owned by the CG the average computed price to replace the boat ramp is $70,358.00. (Table 3) the expected life span of a concrete boat ramp is projected to be 100 years. The installation of a boat ramp may not be viable at all locations due to property owned and shoreline available for installation.

Table 3. Excerpt of SAMS computed boat ramp replacement value.

| Closest UFC 3-701-01 City/Site | Area Cost Factor | Structural Unit (Size) | Unit of Measure | Date Built | Historical Records Adjustment | Planning & Design Factor | Supervision Inspection & Overhead Factor | Contingency Factor | Plant Replacement Value (Computed) | Plant Replacement Value (SAMS) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oakland | 1.34 | 1 | EA | 01/01/1939 | 1.05 | 1.09 | 1.057 | 1.05 | $87,296.04 | $70,704 | Average PRV computed for all CG owned Boat ramps | |
| Bridgeport | 1.19 | 1 | EA | 01/01/1997 | 1.05 | 1.09 | 1.057 | 1.05 | $77,524.10 | $64,861 | | |
| New London | 1.21 | 1 | EA | 04/01/2006 | 1.05 | 1.09 | 1.057 | 1.05 | $78,827.02 | $67,783 | | |
| Mayport | 0.89 | 1 | EA | 07/01/1945 | 1.05 | 1.09 | 1.057 | 1.05 | $57,980.21 | $49,668 | | |
| FL | 1.08 | 1 | EA | 01/01/2003 | 1.05 | 1.09 | 1.057 | 1.05 | $70,358.00 | $49,668 | | |
| Key West | 1.08 | 1 | EA | 01/01/2002 | 1.05 | 1.09 | 1.057 | 1.05 | $70,358.00 | $49,668 | | |
| Key West | 1.08 | 1 | EA | 07/01/1970 | 1.05 | 1.09 | 1.057 | 1.05 | $70,358.00 | $49,668 | 85 Ramps | 70358.003 |

# 4 FINANCIAL

The first three tested boat lift figures were not included due to hurricane damage. The Jet Dock's return on investment is expected to be 7 years (Table 1). The SunStream lift return on investment is expected to be 50 years (Table 2). These figures could vary greatly depending on infrastructure and usage of the lifts. Factors limiting the use of the lifts include but are not limited to; tools and supplies proximity to moorings for maintenance, boat ramp proximity to the unit, unit coxswains comfort level with the lift provided, number of boats at unit to cycle between lift, and number of lifts available for boats at the unit.

# 5 CONCLUSIONS AND RECOMMENDATIONS

The CG relies on boats to meet statutory missions effectively. Operation of these vessels at peak performance is paramount to mission success. The use of boat lifts to increase readiness and lessen the burden on maintenance personnel is based solely on each individual unit that the boat lift might be located. Costs and available infrastructure are unique to each individual location. Some of the costs associated with adding boat lifts include the cost of adding pier space, electrical upgrades, maintenance on the lift as it ages, and natural disasters. Areas that experience ice in winter months will also have increases in the costs due to removal, storage, and consequential resetting of the lift.

Many Coast Guard units utilize vehicles and trailers out of necessity to decrease response times. Other units travel within a large area of operations to access aids to navigation in remote areas a long distance from the unit's base. Thus, standardization of boat lifts is not applicable in all locations.

The life expectancy of boat lifts vary greatly and manufacturer claims must be tested to ensure the return on investment (ROI) is favorable. Assuming the expected life expectancy of the boat lifts to be equivalent to the life cycle of a CG boat at 15 years, they still do not compete well with boat ramps. With the life expectancy of a boat ramp anticipated at 100 years at an average cost $70,358.00 according to SAMS database, replacing or adding boat ramps would be a more cost effective option to consider. Boat ramps are also useful in that they can function for many different boat classes over their life expectancy.

Other factors in cost variation between boat lifts and boat ramps are difficult to account for. For example, trailering boats for maintenance and bringing them into a shop is often easier and more efficient than working on the boat from the pier, but this cost factor is difficult to capture. Some maintenance procedures require special tools, containment for petroleum products, and occasional heavy lifting devices to move major components at the mooring facilities. The time to travel from the tool storage areas to the vessels moorings will vary. Only in instances of CG boats stationed without a boat ramp in a reasonable proximity are boat lifts a viable solution. Individual units must justify the purchase on a case by case basis.

## 5.1 Lessons Learned

Based on the results of this 12-month assessment, if utilizing a boat lift, the response time in launching the boat should be no more than two minutes. The time to recover the boat should be no more than five minutes. Side-tied lifts should only be utilized when attached to floating piers. Fixed piers must have an independent tide management system installed. The ability to walk from each side of the vessel with 270° walk around capability is highly recommended to avoid the potential of mishaps due to jumping across open water to reach both sides of the lift.

**(This page intentionally left blank.)**

# APPENDIX A. REPORT TO CONGRESS

THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

OCT 26 2011

The Honorable Carl Levin
Chairman, Committee on
Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman:

Pursuant to the Fiscal Year 2012 House Armed Services Committee Report (112-78), this letter provides the Navy's Study on Small Boat Maintenance Costs Report to Congress.

The enclosed report presents the result of a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring. The potential savings were evaluated against the cost of procuring, installing, and maintaining boat lifts. The study concluded that there is generally insufficient pay back potential to justify the cost of boat lifts.

A similar letter has been sent to Chairmen McKeon, Inouye, and Young. If I can be of further assistance, please let me know.

Sincerely,

Sean J. Stackley

Enclosure:
As stated

Copy to:
The Honorable John S. McCain
Ranking Member

THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

OCT 26 20[illegible]

The Honorable Howard P. "Buck" McKeon
Chairman, Committee on
Armed Services
House of Representatives
Washington, DC 20515-6035

Dear Mr. Chairman:

Pursuant to the Fiscal Year 2012 House Armed Services Committee Report (112-78), this letter provides the Navy's Study on Small Boat Maintenance Costs Report to Congress.

The enclosed report presents the result of a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring. The potential savings were evaluated against the cost of procuring, installing, and maintaining boat lifts. The study concluded that there is generally insufficient pay back potential to justify the cost of boat lifts.

A similar letter has been sent to Chairmen Levin, Inouye, and Young. If I can be of further assistance, please let me know.

Sincerely,

Sean J. Stackley

Enclosure:
As stated

Copy to:
The Honorable Adam Smith
Ranking Member

THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

OCT 2 6 2...

The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510-6028

Dear Mr. Chairman:

Pursuant to the Fiscal Year 2012 House Armed Services Committee Report (112-78), this letter provides the Navy's Study on Small Boat Maintenance Costs Report to Congress.

The enclosed report presents the result of a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring. The potential savings were evaluated against the cost of procuring, installing, and maintaining boat lifts. The study concluded that there is generally insufficient pay back potential to justify the cost of boat lifts.

A similar letter has been sent to Chairmen McKeon, Levin, and Young. If I can be of further assistance, please let me know.

Sincerely,

Sean J. Stackley

Enclosure:
As stated

Copy to:
The Honorable Thad Cochran
Ranking Member

THE ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

OCT 2 6 [illegible]

The Honorable C. W. Bill Young
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives
Washington, DC 20515-6018

Dear Mr. Chairman:

Pursuant to the Fiscal Year 2012 House Armed Services Committee Report (112-78), this letter provides the Navy's Study on Small Boat Maintenance Costs Report to Congress.

The enclosed report presents the result of a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring. The potential savings were evaluated against the cost of procuring, installing, and maintaining boat lifts. The study concluded that there is generally insufficient pay back potential to justify the cost of boat lifts.

A similar letter has been sent to Chairmen McKeon, Inouye, and Levin. If I can be of further assistance, please let me know.

Sincerely,

Sean J. Stackley

Enclosure:
As stated

Copy to:
The Honorable Norman D. Dicks
Ranking Member

# REPORT TO CONGRESS

## Study on Small Boat Maintenance Costs

**Prepared by**
**Naval Sea Systems Command**
**October 2011**

Preparation of this report/study cost the Department of Defense a total of approximately $26,000 in Fiscal Years 2011 - 2012.

1

# I. Requirement

Pursuant to the Fiscal Year (FY) 2012 House Armed Services Committee (HASC) Report (112-78), the Secretary of the Navy shall conduct a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring and submit a report on the results to the Senate Committee on Armed Services and the House Committee on Armed Services by October 31, 2011. Specifically House Report 112-78 Stated:

*The committee is concerned that the Department of the Navy is not taking advantage of the prospective return on investment and reduced life-cycle sustainment costs that could be achieved through greater investment in corrosion control and prevention measures for the Navy's small boats. Therefore, the committee directs the Secretary of the Navy to conduct a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring and submit a report on the results to the Senate Committee on Armed Services and the House Committee on Armed Services by October 31, 2011. At a minimum, the study shall investigate the potential for reduced maintenance and repair costs of the Navy's small boat fleet through the use of advanced boat lift as well as storage and harboring equipment, including an evaluation and business case analysis of the impact of these strategies for potential improvements to small boat acquisition costs and life-cycle sustainment. In the report to the committee, the Secretary should include recommendations regarding the potential establishment of improved boat corrosion control and prevention as:*

*(1) A key performance parameter for the selection of boat maintenance and storage equipment;*

*(2) A key performance parameter for sustainment;*

*(3) A requirement for the Naval Sea Systems Command to incorporate into its acquisition strategies prior to issuing a solicitation for procurement contracts.*

*The committee directs the Comptroller General of the United States to assess the report submitted by the Secretary of the Navy for completeness, including the methodology used in the Navy analysis. The Comptroller General should submit a report of the assessment to the Senate Committee on Armed Services and the House Committee on Armed Services within 60 days after the date the Secretary of the Navy delivers the study report to the Senate Committee on Armed Services and the House Committee on Armed Services.*

## II. Executive Summary

This Report to Congress presents the result of a study on strategies to reduce maintenance and repair costs associated with small boat storage and harboring. The study sought to answer this main question: is there a business case to expand the use of boat lifts in the Navy? The study concluded that there is generally insufficient pay back potential to justify the cost of boat lifts. This was the case even though the study only analyzed the boats with the strongest potential for pay back.

Boat lifts capable of lifting boats and small craft out of the water are commercially available in a variety of designs and capacities. Removing a boat from the water during periods of non-use has the potential to reduce some types of corrosion and bio-fouling. It can also provide access to the underwater hull and components for maintenance and inspection. A strategy of expanding the use of boat lifts has potential for maintenance cost savings in several areas. The extent of the savings depends on factors such as how the boats are currently stored and moved, local conditions of weather and environment, the boat size, the materials of which the boat is constructed, and details of machinery and appendages. Boat lifts were not found to offer any potential savings with regard to general wastage corrosion, but there is potential for cost savings with regard to corrosion related to dissimilar metals and stray electrical current. The potential for maintenance savings is also limited by environmental regulations regarding industrial processes.

This report addresses the potential cost savings associated with the use of boat lift technologies for lifting, storing and harboring of Navy boats and small craft. The potential savings are evaluated against the cost of procuring, installing, and maintaining the boat lift. This report is not intended to identify any specific boat lift to provide the desired performance, but only addresses the value of the general concept of using boat lifts within the Navy fleet of boats and small craft.

This report concludes that there is generally insufficient pay back potential to justify the initial cost of boat lifts. A significant number of boat lifts have recently been put in service in the fleet. Service experience will be closely monitored and may justify further investigation and possible reconsideration of this conclusion.

## III. Methodology

The term "boat lift" as used in this report refers to a self contained device or system intended to raise a boat floating in the water to a stowed position in which the hull and appendages are no longer in the water. Such a device or system may employ a portable floating concept or a fixed mechanical system attached to a pier or pilings. Some floating systems offer optional features and components that allow the boat lift to be removed from the water. One system allows the boat lift to be pulled from the water complete with the cradled boat using a boat ramp much like a conventional boat trailer.

3

A study was undertaken to address the potential for maintenance and repair cost savings by modifying current maintenance and repair strategies to take advantage of commercially available boat lift technologies. The baseline for this study is current Navy procedures and policies for maintenance and repairs on boats and craft. The relationship between boat acquisition strategies and this maintenance strategy was also identified. Boat maintenance procedures and repair records were broadly analyzed to identify aspects where costs could be reduced by use of a boat lift to avoid in-water storage and/or provide a convenient means to remove the boat from the water for maintenance and repair. A literature search of prior published efforts did not identify any previous work addressing the benefits of boat lifts or other methods of storing boats out of the water. The typical characteristics and costs associated with commercial boat lifts were obtained through a market survey based on products advertised for sale to the general public. The information from the market survey and knowledge of specific boat maintenance items susceptible to cost reduction using a boat lift were then compared to identify particular types or groups of boats that had the highest potential for savings. The specific cost savings were then estimated for individual boat types to identify the best candidates and the maximum expected savings. Feedback from current Navy and Coast Guard users of boat lifts was also solicited as input to the estimated savings potential. Coast Guard feedback provided insight but no hard Return On Investment (ROI) data. ROI is the criteria used to evaluate the identified potential savings.

### A. Maintenance and Repair Baseline

There are currently 2,480 total assets and 58 types of small boats and craft in the US Navy inventory. These boats vary widely in mission, size, age, materials, location and maintenance strategy. Boats are centrally-managed and accounted for as military equipment assigned to a custodian to fill authorized allowances. The boat allowance reflects an activity's validated requirements for a specific quantity and type of boat. Boat allowances drive the budget requirements and ensure the necessary quantities and types of boats are included in boat procurement budget plans and in operation and support budget plans. The Navy procures boats using Other Procurement, Navy (OPN) funding as directed by the Office of Chief of Naval Operations (OPNAV) Resource Sponsors. The boat budget is comprised of a budget line item which has several program elements (depending on the resource sponsor) which correlate to specific boat allowances in the boat inventory. Responsibility for operation and support funding associated with boat custody is borne by the custodian or custodian's chain of command. This includes manning, security, maintenance, and repair of boats in their custody. Boats that are no longer needed by an activity are turned in or transferred to the Boat Inventory Manager (BIM).

Custodians are responsible for maintaining boats and small craft in good working order at all times. Each user command/activity or custodian establishes a boat maintenance program following the policies and procedures contained in Office of Chief of Naval Operations Instruction (OPNAVINST) 4790.4E. Preventive maintenance for all boats is done in accordance with the requirements of OPNAVINST 4790.4. Planned Maintenance System (PMS)

4

maintenance is conducted in accordance with the applicable Maintenance Index Page (MIP) and Maintenance Requirement Cards (MRCs). MIPs and MRCs identify specific maintenance procedures, required supplies, periodicity of procedures and inspections. Technical manuals, either from the manufacturer or developed by the Navy, are also used to develop the maintenance guidance and support the performance of maintenance actions (Naval Ships Technical Manual (NSTM)-Chapter 583, Volume 2). Based on historical data, acquisition costs make up approximately 10 percent of a boat's life cycle cost, and operations and maintenance approximately 90 percent. If inspection of a boat reveals that it was not properly maintained, the Navy boat program manager can request, via the chain of command, that the custodian command/activity identify funding to return the boat to a serviceable condition. The BIM has boat disposition authority. Boat dispositions, turn-in, transfer and disposal (including cannibalization) are authorized by the BIM. Typical reasons for removing a boat from service are: 1) Operational/mission obsolescence; 2) Material Obsolescence (new technology such as fiberglass boat hulls makes old technology such as wood hulls obsolete); 3) Environmental Obsolescence (change in environmental laws); or 4) Damage that is beyond economical repair.

Navy maintenance policies and actions are designed to ensure crew and ship safety while achieving desired operational readiness levels at the lowest possible total ownership cost, consistent with public law and other directives (OPNAVINST 4700.7L). Boat and craft maintainers must scale practices and procedures to be consistent with the value of boat assets and their allotted maintenance budget. Typically the larger the boat or craft is, the more the maintenance program parallels that of larger Navy ships. Maintenance procedures and schedules for Navy ships and related equipment are developed and performed using a Condition-Based Maintenance (CBM) strategy whenever practical. The goal of CBM is to perform maintenance only when there is objective evidence of actual or predictable failure of installed systems or components, while ensuring operational readiness, safety, and equipment reliability in a cost effective manner. CBM is primarily a function of use, or hours of operation. Another strategy is Reliability Centered Maintenance (RCM) which involves replacement of items as a result of a predicted failure rate based on a reliability model. A third strategy is Time Based Maintenance (TBM) resulting from predicted wear-outs. This method might be used for items that degrade as a function of time rather than service, such as hoses or batteries. A final strategy is Preventative Maintenance, which is maintenance designed to prevent or discover functional failures. In general, the Navy PMS uses RCM principles per MIL-STD-3034, to develop preventive maintenance utilizing CBM and TBM as applicable. This is based on Failure Modes and Effects Analysis (FMEA) and a determination of whether a failure mode is risk/cost effective to prevent, or whether best allowed to run-to-failure. Maintenance procedures and schedules for boats use these same ship strategies as a general starting point, but substantially scale and tailor actual maintenance actions to specific boat characteristics, such as hull type, engine type, etc.

Maintenance is also broken down by the level at which it is accomplished: Organizational, Intermediate, or Depot (O, I or D) depending on the complexity of the task. For boats and small craft, the majority of the maintenance is accomplished at the O and I levels. I and D level maintenance usually requires additional scheduling and logistics elements to ensure available facilities, expertise, and funding. Once in the fleet, appropriate maintenance strategies are put in place for boats and craft. This involves tailoring the most cost effective set of maintenance methods accomplished at the lowest possible level with the least impact to availability of the boat over its service life.

The maintenance actions in place for boats are efficient, effective, and have evolved from the general Navy maintenance strategies over many years. They are stable and effectively meet the needs of today's Navy. It is unlikely that any individual procedural change will lead to a macro level change in these proven strategies. However, integrating the increased use of boat lifts into the existing strategies might yield some cost benefit for specific combinations of location, mission, design features and materials. The question addressed by this study is whether that set of circumstances exists and provides sufficient benefit to justify further investment in boat lift technology.

## B. Relation of Acquisition Strategies to Maintenance

Navy boats are procured by the Navy boat program manager, unless otherwise formally delegated. The Chief of Naval Operations (CNO), via OPNAV resource sponsors, provides the funding for boat procurement. The majority of boats and craft are procured from commercial boat builders in one of four ways: as standard products; as mostly standard products with modifications for specific applications; as a custom industry design developed to meet a performance specification; or as a custom Navy design developed for a specific application. The first two methods are by far the most predominant. Use of Commercial Off-The-Shelf (COTS) products in this manner has many cost benefits, reduces acquisition / contractual risk, and takes advantage of the skills and knowledge of the boat building industry. A critical element of current maintenance strategies is to select, specify, or design boats that are made from materials and use components that are known to require as little maintenance as possible over the life-cycle of the asset. Naval boat procurement requirements include maximum use of corrosion resistant materials including chemical resistant resins for composite structures, marine grade aluminums, ungrounded electrical systems and isolation of dissimilar metals to prevent galvanic corrosion. These have proven over time to be a good maintenance investment, reducing the need for maintenance in many instances. Often more challenging are standard manufactured components that use less corrosion resistant materials or fasteners. Unless there is a larger commercial market for more corrosion resistant versions of these components they are often cost prohibitive to obtain by specification or modification of standard items. Wood, wood products and other organic materials are generally prohibited on Navy boats due to the degradation these materials experience in damp or wet conditions and the near impossibility of preventing water intrusion on a boat. Specifying materials proven to provide good service in a saltwater

environment preempts corrosion problems and saves the Navy maintenance money and manpower.

### C. Boat Lift Characteristics and Costs

Boat lifts are designed to raise a boat out of the water in order to reduce the effects of the saltwater environment on the hull, appendages, and exposed machinery components. These effects include: attachment of biological growth such as algae and barnacles, saltwater corrosion, galvanic (dissimilar metals) corrosion, and corrosion enhanced by stray electrical currents from onboard and shore side electrical systems. Getting the boat out of the water also enables some maintenance or repairs that require access to parts of the boat normally in the water, such as under water hull inspections. Both fixed and floating boat lifts will require dedicated pier space to operate, usually more space than would be normally required by the boat alone (about 50 percent greater width typically). Pier space is extremely limited at many facilities. Use of boat lifts may mean new pier space would have to be created or existing pier space sacrificed unless the device can be moored apart from a pier. For purposes of this study, the costs of creating new pier space were not estimated. Every boat lift is a mechanical device in a saltwater environment and will have some maintenance costs of its own. Other costs include the cost of transporting, launching and recovering and, in the case of a fixed lift system, installing the lift. Floating lifts vary in their ability to survive local sea conditions compared to a properly secured boat by itself. Depending on the particular design, a boat lift may add complexity to the launch and recovery process, which may adversely impact availability.

The Navy currently has approximately 60 “in-service” boat lifts of the floating portable type, most of which have a 13,000 lb lift capacity. Of those 60, there are eleven boat lifts with a 24,000 lb lift capacity, and five associated transporters (allowing them to be towed out of the water via a ramp) under contract. Seven of the eleven 24,000 lb lift capacity boat lifts have already been delivered to the Navy; of those seven delivered boat lifts, two (and two transporters) have been assigned and are in route to a custodian. None of the delivered 24,000 lb lift capacity boat lifts are in use yet.

A market survey gathered specific characteristics and costs of representative boat lifts. Nine vendors were identified in an internet search and contacted to get more information via a market survey. They represent three floating (two floating docks and one detachable floating lift) and six fixed boat lifts. All nine offered units with a lift capacity at or near the top of the available off-the-shelf capacity range. Each vendor was sent a set of questions tailored to the type of unit they offer. Eight vendors responded with specific information or directed us to websites that contained product information. Four vendors provided pricing information for their product line.

The survey addressed the following areas:

7

1) Initial cost and availability through the General Services Administration (GSA) schedule.

2) Dimensions and operational clearances.

3) Available operation, maintenance, or other technical documentation.

4) Service life and warranty.

5) Operating limits (including environmental conditions and materials compatibility).

6) System operating pressures where applicable.

7) Boat interface issues such as contact pressures and accommodating Rigid Inflatable Boat (RIB) sponsons.

8) Known service failures and associated reliability data.

9) Transportability and transportation procedures.

10) Total ownership cost.

Typically the vendors provide a range of products that increase in cost as the lifting capacity increases. This information is summarized in Figure 1. Survey responses were used to estimate a range of likely installation costs and maintenance costs associated with a typical boat lift and a range for expected service life.

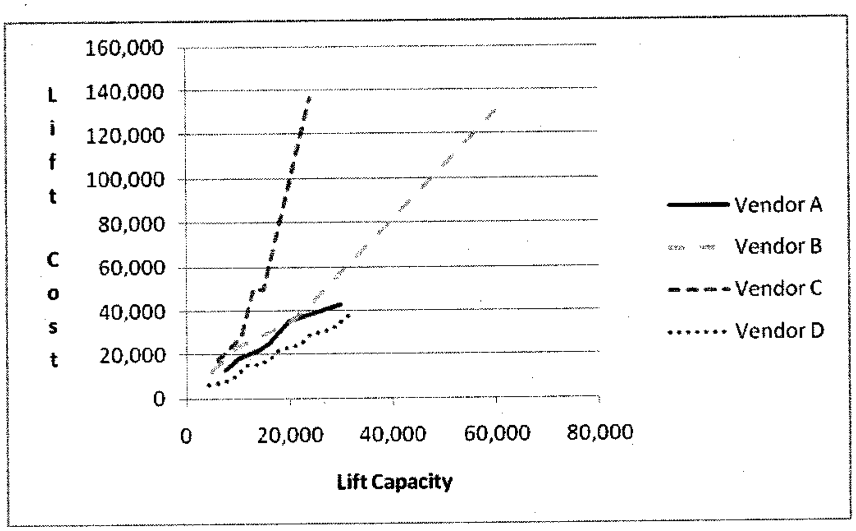


**Figure 1 Purchase Price vs. Lift Capacity**

Purchase price data is based on response to the market survey, not in response to a formal Request for Proposal/Request for Quotation (RFP/RFQ). All vendor responses were treated as equally accurate. Market survey data was used for this study.

### D. Maintenance and Repair Costs Susceptible to Savings

**Corrosion**

The decrease in corrosion associated with taking a boat out of the water and the associated benefit of this reduced corrosion in dollars is a useful measure of the value of adopting boat lift systems. However, corrosion is difficult to predict and quantify. On systems as complex as boats, it becomes even more difficult because of the types of corrosion and the numbers of variables involved. For example, in addition to steel boats corroding in salt water, all metal boats typically have dissimilar metals in close proximity which form a galvanic cell when in an electrolyte such as salt water, leading to an accelerated corrosion rate. Fasteners, fittings, and outdrives are particularly prone to this type of corrosion. Boats tied to a dock with electrical grounding issues are often subject to stray electrical currents which can also accelerate corrosion rates. The rate of corrosion associated with stray current is similar to galvanic corrosion in that it is dependent on the boat conditions and water conditions, but adds random variables associated with the magnitude of the source. This corrosion cannot be predicted or estimated for a general case. General wastage corrosion of the hull is not improved by removing it from the water if the boat remains in the saltwater environment and may actually put the boat in a more corrosive zone subject to salt air and sea spray. There are measured rates for bare steel corrosion in salt water but our hulls are protected with coatings. It would only be the areas where the coating was damaged where corrosion at this rate would occur. Marine grade aluminum and Glass Reinforced Plastic (GRP) composite hulls are not subject to similar general corrosion issues. Consequently general wastage corrosion will not provide a source of cost benefit. Complicating matters further is the existence of corrosion protective measures and systems. Examples of these include special paints and coatings put over metals, zinc anodes mounted in areas where a galvanic circuit exists, and even active corrosion protection systems used by some outdrives and hulls where a trickle charge from the battery creates a protective zone around expensive components, reducing the galvanic potential of a localized area.

The rate of corrosion for a galvanic cell is unique to the constituent metals, the water conditions, and factors associated with any cathodic protection, such as proximity to zincs, surface area of zinc anodes, etc. Therefore the range of corrosion rates is not something that can be obtained without specific measurements. A visual indicator is the rate at which properly installed zinc anodes are consumed. However, the reduced corrosive effect can be estimated by determining the amount of time the circuit is broken by removing the boat from the water (electrolyte). For boats that spend the majority of their service life in the water, the zinc anodes are immersed 24/7, for a total of 8,736 hours per year. Assuming 1,000 hours per year operating time, the balance of time could be spent on a boat lift. Consequently, zinc life should go up

correspondingly. Force Protection (FP) boats operating 24 hours a day and 7 days a week are in the water two-thirds of a year (5,840 hours) now, but a boat lift would reduce this by half, or 2,920 hours, extending zinc life by 2 times. There are standard formulas for estimating the amount of zinc anode required for protecting a metallic hull from galvanic corrosion. Using these formulas, Navy experience on the required periodicity of anode replacement, and typical zinc costs allows the savings for zinc anode replacement to be estimated based on the reduction of hours of sea water exposure realized by use of a boat lift.

**Other Maintenance Actions**

Another source of potential cost savings is through reduced cost of performing maintenance actions not related directly to corrosion. A Review of MRCs and MIPs was conducted to identify the additional candidates susceptible to reduction by use of a boat lift.

It is important to recognize that many of the maintenance actions normally associated with boat ownership are impacted by pollution restrictions. In 1990, the U.S. Environmental Protection agency (EPA) developed permitting regulations under the National Pollutant Discharge Elimination System (NPDES) to control storm water discharges associated with eleven categories of industrial activity. As a result, NPDES permitting authorities, which may be either EPA or a state environmental agency, issue storm water permits to control runoff from these industrial facilities. For example, cleaning the hull by scraping or power washing will lead to pollutants potentially dropping into the water and therefore requires a permit. Disassembly of any equipment or system that might lead to contaminated bilge water dropping in the water also requires a permit. Painting over the water also requires a permit as the paint may drop into the water. Common requirements for coverage under an industrial storm water permit include development of a written Storm Water Pollution Prevention Plan (SWPPP), implementation of control measures, and submittal of a request for permit coverage, usually referred to as the Notice of Intent or NOI. The best management practices for these maintenance actions are restrictive, particularly for actions that might be undertaken while in a boat lift over the water. Thus potential cost savings benefits of expanding the use of boat lifts quickly diminish. There are still other important maintenance actions (outside of those restricted by environmental compliance requirements) that can lead to cost savings. Maintenance actions such as hull inspections, hull appendage inspections, engine anode replacements on outboards and frequency of cleaning bio-fouled hulls all offer some potential savings.

Both hull inspection and appendage inspection requires the boat to be out of the water and assumes that the boat lift provides adequate clearance and scaffolding to support an inspector. Since these would likely occur together, a boat lift could reasonably eliminate the need for one removal per year. Similarly, inspection/replacement of outboard engine anodes assumes adequate staging and clearance on the boat lift, but since the periodicity is twice a year, one removal per year can also be eliminated on these boats. Although hull cleaning cannot be done on the boat lift due to environmental restrictions, removing a hull from the water will

reduce the amount of bio-fouling on the hull and correspondingly reduce the need for cleanings. Bio-fouling, like corrosion, has many regional and environmental factors associated with its formation. A reasonable assumption for the reduced growth would be half normal growth. This then ties into the periodicity of hull cleaning for the area where the boat is located.

**Repairs**

A third potential area for cost savings through use of a boat lift is in the area of repairs made to boats and small craft. Repairs could include minor changes of parts, patching holes, or performing diagnostic inspections for equipment that is not performing as expected. Environmental restrictions must also be considered relative to candidate repairs and the ability of a crew to perform the repair safely and effectively from a boat lift must be considered. Boat repair logs for the past three to five years were reviewed. No repairs that could have been done more effectively or cost efficiently on a boat lift were found. Most common repairs are either accomplished within the hull and are, therefore, independent of whether the boat is floating or out of the water, or could not be accomplished while on a boat lift for environmental, safety, or accessibility reasons.

## E. Boat and Small Craft Inventory Analysis

Using knowledge gained of typical boat lift capabilities and potential areas for cost savings associated with using boat lifts, the total boat and small craft inventory was analyzed to identify specific candidate boat types for more specific estimates of potential cost savings. As of August 8, 2011, there were 2,480 boats in the inventory. All subsequent filtering was done on this inventory snapshot.

**Filter 1 – Size and Shape**

The first boat category filter used was the physical size and shape of the boats. Boats in the current inventory vary in length from 5m to over 200 feet and in weight from a few thousand pounds to several hundred tons. However, the majority of the boats are less than 50 ft. as seen in Figure 2.

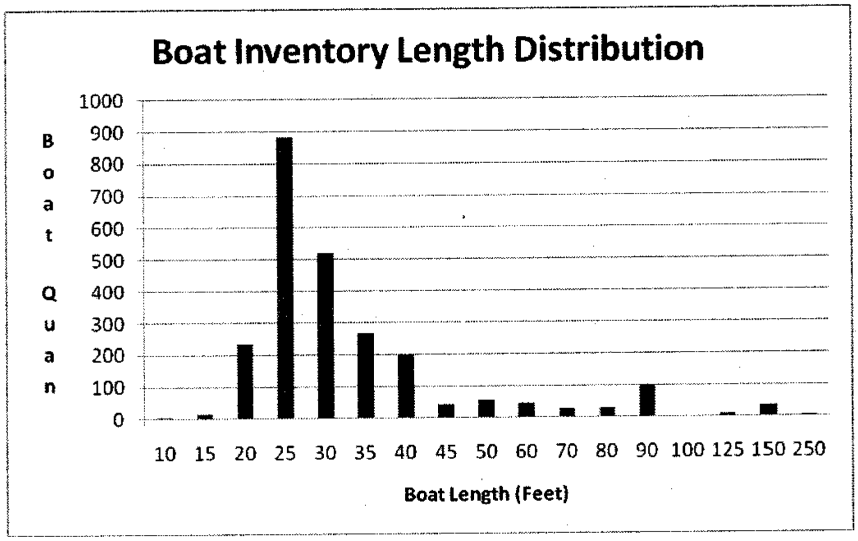


**Figure 2. Boat Inventory Length Distribution**

There is limited benefit associated with the smaller hulls (18 feet or less) since they are generally less complex, cost less, and have correspondingly less payback potential. Boats 18 ft or less and 50 ft or greater in length were eliminated. These filtering values were selected because they represent the upper and lower limits of what can be reasonably removed from the water by the boat lifts identified and are in the fleet in sufficient quantity to provide the most potential for total savings to the Navy.

Data collected by the market survey found the upper capacity of existing boat lifts provided by most vendors to be in the 24,000 to 30,000 lb range. Consequently, boats in excess of 30,000 lbs were eliminated from consideration.

Finally, the market survey found that available boat lifts appear to target a "V" hull configuration. Several boat types in the Navy inventory have large appendages or unusual hull shapes not typical of the general boating market. These hulls were not considered candidates for use on boat lifts because not all of the lifts can accept these features. There are 1,912 of the 2,480 boats that meet the filter criteria for size and shape.

**<u>Filter 2 - Mission</u>**

The mission filter removed boats from consideration that had to have a trailer as part of their mission for mobility or boats that are normally stored on a ship. Of the 1,912 boats passing the first filter, 815 meet these criteria.

**<u>Filter 3 – Trailers (non-mission critical)</u>**

Of the 815 boats remaining after Filter 2, all but 36 have trailers even though having a trailer is not considered mission critical for these boats. Trailers, like boat lifts, help to reduce

12

maintenance costs, but also provide for timely and cost effective logistical movement. If a boat has a trailer, only the difference in the benefit offered by a boat lift over the benefits of a trailer can be considered as a potential cost savings. However, for boats with no trailer, all the potential benefit from a boat lift can be considered and consequently should offer the most potential for savings benefit.

**Filtered Results**

Table 1 is a summary of these filters applied to the boat and craft inventory snap shot.

| Characteristic | Quantity | % of Inventory |
|---|---|---|
| Size and Shape Filter 1 | 1912 | 77% |
| Add Mission Filter 2 | 815 | 33% |
| Add Trailer Filter 3 | 36 | 1.5% |

**Table 1. Summary of Filtered Candidates**

Further review of these 36 found that 12 smaller boats in use at the Naval Academy are very inexpensive GRP hulls which have low maintenance and are not likely to justify use of a boat lift. The cost savings potentials of the remaining 24 boats were considered the most likely to justify the cost of a boat lift.

A group of 146 shore based FP boats was eliminated by Filter 2 but was pulled back into consideration as a special case. The assumptions related to trailers are not completely applicable to these boats because of their unique operational profile. A group of three of these boats provides 24/7 coverage. One is in service, one is in the water at the ready, and one is on a trailer getting serviced. At eight hour intervals, they rotate. All of these boats have trailers, but two trailers are always empty. The boat that is left at the dock could use a boat lift to raise it out of the water while it is waiting. This would reduce its time in the water by 50 percent. There is the potential for savings from reduced bio-fouling, but it is expected the maintenance will be performed while the boat is on the trailer.

These two groups of boats totaling 170 boats were then reviewed for potential benefit and possible savings. It was considered logical to initially limit the most detailed investigation to these boats that offer the most potential for cost savings and, therefore, are most likely to justify the cost of a boat lift.

### F. Estimated Savings by Boat Type

Three areas of potential savings from the use of boat lifts were identified in a broad based review of current maintenance and repair strategies: reduced galvanic corrosion, reduced periodicity of underwater hull and appendage inspections requiring the boat to be taken out of the water, and reduced periodicity of hull cleanings. Engineering estimates and fleet feedback were used to assess the magnitude of the savings. The 24 boats remaining in consideration after

13

inventory analysis and filtering plus the 146 FP boats were evaluated in these three areas and specific estimates of cost savings developed using the particular characteristics and maintenance requirements for each boat type. These estimated savings were used in the business case analysis.

## IV. Potential for Reduced Maintenance and Repair Costs

Cost savings were identified for boats not provided with trailers and FP boats in the areas of reduced galvanic corrosion, reduced periodicity of underwater hull and appendage inspections requiring the boat to be taken out of the water, and reduced periodicity of hull cleanings. The magnitude of the potential savings varies with the specifics of each boat type and mission parameters. The magnitude of the potential savings can be characterized as modest, but not insignificant. An evaluation in terms of ROI was undertaken to analyze the costs versus the potential savings.

## V. Evaluation and Business Case Analysis

The evaluation and business case analysis determined the potential cost benefit in the following manner. The study collected data from the existing boat inventory, maintenance procedures and practices such as inspections, and maintenance actions related to corrosion and bio-fouling to determine payback on a boat lift investment. Potential maintenance cost savings are summarized in Table 2 below using a $65/hr labor rate. A range is shown for the estimates where the savings was dependent on hull material; the calculations used the specific value appropriate for each of the 170 boats identified as candidates.

| Boat/Craft | Action | Periodicity | Maintenance effort reduction | Man-hours per year | Savings per year |
|---|---|---|---|---|---|
| All | Hull inspection | 1/yr | Reduce by 1 boat removal/yr | 4 | $260 |
| All | Appendage Inspection | 1/yr | | 4 | $260 |
| Outboards | Engine anode | 2/yr | Reduce by 1 | 4 | $260 |
| All | Hull cleaning/ Bio-fouling | 1/yr or as needed | Reduced by .5-2 hull cleanings | 10-80 (by hull material) | $325-$13,000 |

**Table 2. Maintenance Actions Susceptible to Reduction by use of a Boat Lift**

Data for lift installation and lift maintenance costs was collected and used to determine range estimates for the total cost associated with using boat lifts (Table 3). The cost minus the potential savings was then used to determine if a savings benefit existed. Due to the number of different conditions and variations by boat, a software program was used to determine gross savings potential. Range values were input as probability distributions. Bounds for the range of

| Cost Action | Man-hours | Cost Range |
|---|---|---|
| Installation | 16-80 | $1,040-$7,800 |
| Lifting Service Rental | N/A | $5,000-$10,000 |
| Annual Lift maintenance | 8-12 | $260-$1,170 |

**Table 3. Range of Costs in Addition to Initial Boat Lift Purchase Price**

each distribution were determined based on prior field experience with similar equipment or current technical data. These distributions were then incorporated with the cost model using a software program called *Crystal Ball* to determine the cumulative probability of the Navy seeing a return on the boat lift investment.

The peculiar operational profile of the FP boats warrants an explanation as to service life assumptions for boats and small craft. The service life of any boat is dependent on a number of factors, such as age, usage, operational demands, etc. For planning and inventory management purposes the service life of Navy Standard 7-meter RIBs and Navy Standard 11-meter RIBs is deemed to be 12 years, other boats have an expected service life of ten years when routinely operated at less than 1,000 hours per year, and boats such as Force Protection boats that have 24/7 operational requirements have an expected service life of seven years. A few, generally larger, steel and aluminum boats have service life expectancies of up to 25 years (NSTM 583, P 1-20). For purposes of this study a 12 year service life was used for RIBs, seven years for the 24/7 boats, and ten years for everything else. The risk model created in *Crystal Ball* considered every boat in the group of 24 identified with the greatest cost savings potential, the 146 Force Protection boats in the high tempo operations scenario, and combined information for all lifts. *Crystal Ball* ran the model and estimated this total impact using Monte-Carlo simulation techniques and ran 5,000 simulations. *Crystal Ball* estimates risk by putting risk ranges on low level inputs of an estimate. *Crystal Ball* then runs the estimate numerous times and generates a cost to probability curve. These distributions were then incorporated with the cost model using *Crystal Ball*. A point estimate was developed to create a singular point of reference for cost to implement boat lifts. Risk ranges were then created around the point estimate inputs to populate the *Crystal Ball* model. The software then calculates the cumulative probability of the Navy seeing a return on the boat lift investment. The results of this analysis are shown on Figure 3.

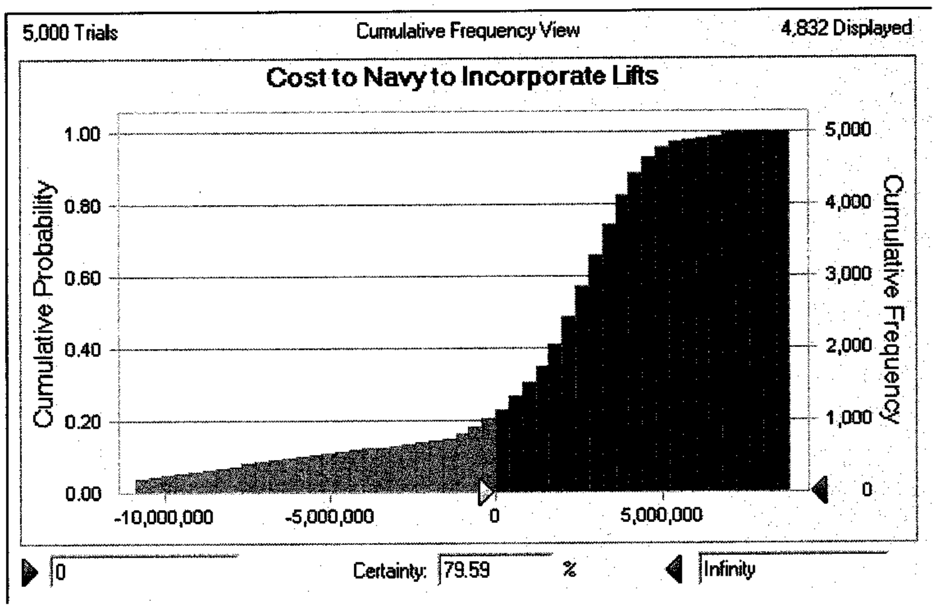


**Figure 3. Lift Implementation Cost ($) Over Life of 170 Candidate Boats**

The result in Figure 3 shows the cost weighted average over the life of all 170 boats considered as having the most potential benefit by the study. The red bars show the probability of getting a return on the investment, with a 20.41 percent probability of breaking even. The blue bars show the probability that the Navy will incur additional costs by implementing the boat lifts as opposed to current maintenance and boat storage and harboring methods (79.59 percent). Based on this analysis, Navy concludes it is unlikely that implementing boat lifts will provide a return on investment.

## VI. Recommendations for Improved Corrosion Control and Prevention

A significant number of boat lifts have recently entered service in the fleet. Service experience will be monitored and may provide a basis for future decisions regarding the use of boat lifts for corrosion control and prevention.

Key Performance Parameters (KPPs) are those attributes or characteristics of a system that are considered critical or essential to the development of an effective military capability and those attributes that make a significant contribution to the characteristics of the future joint force as defined in the Capstone Concept for Joint Operations. A decision to make boat corrosion control and prevention a key performance parameter implies that corrosion control and prevention on all boats and craft is as important as typical KPP's like speed or range. This is not the case. Boats and craft have a relatively short service life, are made of mostly corrosion resistant materials, and have missions where mission success or crew safety might be adversely impacted if range or speed is sacrificed. Efforts have been made to eliminate items and

16

equipment from boats and craft that have been corrosion problems in the past, such as wire rope and non-stainless steel hardware. Corrosion is a function of time and can usually be controlled with active maintenance. It does not have the urgency or mission value normally associated with KPPs; it is more appropriate to view it as an important design consideration.

### (1) As a Key Performance Parameter for Selection of Boat Maintenance and Storage Equipment

Improved corrosion control and prevention is not recommended as a KPP for selection of boat maintenance and storage equipment. However, it is recommended that boat maintenance and storage equipment be selected based on its potential benefit to corrosion control and prevention on boats and craft. Unfortunately, improved corrosion control and prevention will be hard to clearly define and measure making them inappropriate for KPPs. Evaluating these factors on the basis of ROI as done in this study should prove more useful in ensuring effective use of Navy resources. In the selection of boat maintenance and storage equipment, corrosion control and prevention for the equipment itself must also be a consideration. Boat maintenance and storage equipment should provide flexibility in handling many hull forms, reliability, transportability, and ease of operation. ROI calculations should include the total cost of introducing the equipment into the fleet, including installation, logistics support, training, and development of operational procedures. The operational restrictions due to environmental conditions (ice, wave height, wind, etc.) should also be evaluated.

### (2) As a Key Performance Parameter for Sustainment

Use of improved corrosion control and prevention is not recommended as a KPP for sustainment. Sustainment involves the supportability of fielded systems and their subsequent life cycle product support - from initial procurement to supply chain management (including maintenance) to reutilization and disposal. It includes warehousing, and depot and field level maintenance. Sustainment includes assessment, execution and oversight of performance based logistics initiatives, including management of performance agreements with force and support providers; oversight of implementation of support systems integration strategies; application of diagnostics, prognostics, and other condition based maintenance techniques; coordination of logistics information technology and other enterprise integration efforts; implementation of logistics footprint reduction strategies; coordination of mission area integration; identification of technology insertion opportunities; identification of operations and support cost reduction opportunities and monitoring of key support metrics. Boat corrosion control and prevention is certainly an important aspect of sustainment, however, it is not sufficiently definable to be used as a KPP. The boat corrosion and control prevention aspect of sustainment is not a stand-alone testable quantity; therefore it fails an important criterion for a KPP.

### (3) As a Requirement for the Naval Sea Systems Command to Incorporate into Acquisition Strategies Prior to Issuing a Solicitation for Procurement Contracts

Boat corrosion prevention and control requirements are already a well established part of the requirements used by Naval Sea Systems Command (NAVSEA) in its acquisition strategies for procurement contracts for boats and craft. A review of current fleet repair and maintenance procedures and records does not reflect a need for additional requirements. NAVSEA currently has corrosion control as part of its acquisition strategies in compliance with NAVSEA Instruction 9630.1 to the extent that is cost effective for boats and craft. Corrosion control and planning is addressed through performance requirements, design requirements, and contractual requirements to the extent possible on the contractual vehicles used by various procurement strategies. Individual procurement costs typically are less than a half-million dollars; corrosion prevention measures are proportionally appropriate to the cost of the asset.

## VII. Summary

The results from the ROI analysis indicate that there is insufficient pay back potential to justify the cost of boat lifts. Since only the boats with the most payback potential were used in the ROI analysis, further investigation into pay back potential from other boats is unlikely to uncover additional cost savings for the government at this time. Also, the cost of adding new pier space to accommodate boat lifts was not included in the cost estimates, increasing the confidence in the study results. A significant number of boat lifts have recently entered service in the fleet. Service experience will be monitored and may provide a basis for future decisions regarding the use of boat lifts for corrosion control and prevention. Below is a point-by-point response to specific direction and information requests contained in HASC Report 112-78:

*Request: "Investigate potential for reduced maintenance and repair costs through the use of advanced boat lift as well as storage and harboring equipment."*

Response: The Navy finds there is a potential for reduced maintenance and repair costs through the use of boat lifts as well as storage and harboring equipment, but that potential is not cost effective when the procurement, installation and maintenance costs associated with the boat lifts is taken into account.

*Request: "Evaluation and business case analysis of the impact of these strategies for potential improvements to small boat acquisition costs and life-cycle sustainment."*

Response: The Navy evaluation of ROI showed insufficient pay back potential to justify the cost of boat lifts.

*Request: "Recommendations regarding the potential establishment of improved boat corrosion control and prevention as:"*

18

*A. "A key performance parameter for selection of boat maintenance and storage equipment."*

Response: The Navy concurs with the importance of these considerations, but does not recommend them as KPPs.

*B. "A key performance parameter for sustainment."*

Response: The Navy concurs with the importance of these considerations, but does not recommend them as KPPs.

*C. "A requirement for the Naval Sea Systems Command to incorporate into its acquisition strategies prior to issuing a solicitation for procurement contracts."*

Response: The Navy concurs with the need for these requirements and finds that they are already implemented in boat acquisition strategies in accordance with NAVSEA policy.

## Acronyms

BIM – Boat Inventory Manager
CBM – Condition Based Maintenance
CNO – Chief of Naval Operations
COTS – Commercial Off-The-Shelf
EPA – Environmental Protection Agency
FMEA – Failure Modes and Effects Analysis
FP – Force Protection
GRP – Glass Reinforced Plastic
GSA – General Services Administration
HASC – House Armed Services Committee
KPP - Key Performance Parameter
MIP - Maintenance Index Page
MRC – Maintenance Requirement Card
NAVSEA – Naval Sea Systems Command
NOI – Notice Of Intent
NPDES – National Pollutant Discharge Elimination System
NSTM – Naval Ships Technical Manual
OPN – Other Procurement Navy
OPNAV – Office of Chief of Naval Operations
OPNAVINST - Office of Chief of Naval Operations Instruction
PMS – Planned Maintenance System
RCM – Reliability Based Maintenance

19

RFP– Request For Proposal
RFQ– Request For Quotation
RIB – Rigid Inflatable Boat
ROI – Return On Investment
SWPPP – Storm Water Pollution Prevention Plan
TBM – Time based Maintenance

# APPENDIX B. REPORT OF INITIAL INSTALLATION

## B.1 Selection and Solicitation

The RDC initiated a solicitation: HSCG32-12-Q-SAP011 for the purchase and installation of free floating lifts at three unit locations in New England. A contract was awarded to HydoHoist Marine Group Inc. for the installation of 3 separate lifts at units in Shinnecock NY, Bayonne NJ, and New Haven CT. The lifts were all installed IAW statement of work and the station crews were properly trained to operate the installed lifts.

## B.2 Hurricane Sandy

Within one month of installation Hurricane Sandy destroyed all three lifts (Figures B-1, B-2) leaving the project with less than one month of data to compare results. Damaged equipment repair cost exceeded the cost of replacement. Boat lift pontoons on all the lifts were holed and brackets and lifting hinges were sheared. Watertight integrity was compromised in many areas on all three lifts. Due to the cost exceeding replacement all three lifts were disposed of in accordance with Commandant Instruction M4500.5.

Figure B-1. Damaged guide and belly band.

Figure B-2. Damaged area of pontoon.